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Prototype constructions in early language acquisition

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Abstract

In this paper we bring together several lines of cross-linguistic research to demonstrate the role of prototypicality in young children's acquisition of the transitive construction. Much research has shown that young children are slow to form abstract constructions because they fail to see the more general applicability of syntactic markers such as word order and case marking. Here we attempt to explain this fact by investigating the nature of the language children do and do not hear, specifically, the reliability and availability of the linguistic cues they are exposed to. We suggest that constructions redundantly marked with multiple cues could have a special status as a nucleus around which the prototype forms—which makes it difficult for them to isolate the functional significance of each cue. The implications of this view for language acquisition are discussed within a usage-based framework.

Keywords

language acquisition, input, construction, prototype, grammar

1. Introduction

One of the great theoretical advances in modern linguistics is the recognition that grammatical constructions are conventionalized pairing of complex forms with complex semantic/pragmatic functions. Phrasal patterns

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and the rules of syntactic combination not only have meaning but also have the capacity to change the meanings of the words they govern (Croft 2001; Fillmore 1989; Fillmore et al. 1988; Goldberg 1995, 2006; Kay and Fillmore 1999; Lakoff 1977; Langacker 1987; Michaelis and Lambrecht 1996). This is the key insight that enables us to abandon the unproductive mathematical metaphor for grammar (as, for example, in traditional phrase-structure-based theories of grammar) in which words have meanings but grammatical “rules” are totally formal and without meaning or function (Tomasello 1998, 2005). In this more functional view, a person’s grammatical competence is best characterized as a taxonomy of constructions that are organised from fully specified instances to more abstract representations, along with skills for using those constructions to communicate with other persons in particular usage events (Langacker 2000).

The problem for language acquisition is that children do not experience constructions but only utterances; they must (re-)construct for themselves the constructions of their language from the individual utterances they experience. Of particular importance as targets of acquisition are the relatively abstract utterance-level constructions that enable children, at some point, to generate an almost unlimited array of particular utterances following the same general form: for example, transitive, intransitive, ditransitive, passive, cleft, yes-no question, wh- question, identificational, attributional, caused motion, and intransitive motion constructions. But in the usage-based view of language acquisition, children do not begin with abstract constructions such as these, but rather with constructions that are concrete and item-based with only limited and local abstractions (Tomasello 1992, 2003). Thus, for example, children first acquire a number of different verb-island constructions (e.g., *X hits Y*, *X kisses Y*, *X pushes Y*, *X pulls Y*, etc.) and use these in generating utterances before these coalesce into a verb-general transitive construction.

The central question in any construction-based, usage-based theory of language acquisition is thus how children get from more concrete and item-based constructions to more abstract constructions. Tomasello (2003) has emphasized the general cognitive processes of (i) analogy, for forming abstract syntagmatic schemas across phrases; and (ii) distributional analysis, for forming paradigms of items that might go into particular slots in the schemas. Goldberg (2006) has proposed that this process is facilitated by the fact that in adult language certain verbs are prototypical for certain argument-structure constructions; for example, the verb *give* is closely associated with the ditransitive construction. Thus, young children hear exemplars of the ditransitive construction most often with the verb *give* and so, in an important sense, acquiring the meaning of the

verb *give* and acquiring the ditransitive construction are part of the same process. Although skewed input of this type may facilitate learning (Goldberg 2006: 89), it isn't necessary for children to acquire abstract constructions. Perhaps a case in point is the transitive construction, which in English is so general in function—something like, prototypically, Talmy's (1988) force-dynamic schema—that no one verb may be considered prototypical (and there is no evidence, to our knowledge, that one transitive verb in English is most frequently experienced by all children). Of course that does not imply that children comprehend the semantic roles of all transitive verbs in the same way. Pyykkönen and colleagues (submitted) showed fifteen 3-year-olds a screen displaying two characters and a location while they listened to a story of the following form: 1. *The X [verb]ed the Y near the [location].* 2. *Do you know what happened next?* 3. *He did something very silly.* 4. *He [verb]ed.* The children had stronger expectations about referents with high-transitivity verbs such that they looked for both subject and the object significantly longer for prototypically transitive verbs such as *kissed*, *kicked* and *hit*, than for those with low-transitivity verbs such as *bumped*, *found* and *loved*. The fact that the effect of verb semantics was detected quickly in the children's eye-movements (between 520 to 2600ms) suggests that they, like adults, can rapidly generate expectations about the upcoming discourse (Koornneef and Van Berkum 2006) and that these expectations are guided to some extent by a cline of transitivity. So, in the case of the transitive construction—and to some degree in the case of all argument-structure constructions—the prototype is formed not by a verb but by a gestalt of grammatical markers such as word order, marking on the noun and/or verb, as well as semantic cues.

In the current paper, we develop a prototype-based view of the acquisition of argument-structure constructions, with particular reference to the transitive construction. The transitive construction is important as it is present in almost all languages in one form or another (Hopper and Thompson 1980), and ontogenetically-speaking, it is the earliest in which comprehension rests crucially on being able to successfully identify which participants are playing which roles in the event (who is doing what to whom).

We focus here mostly on experimental research, as experiments are necessary to determine the level of abstraction at which children are working. Most of the early research was done in English, but recently there have appeared some cross-linguistic experimental studies that are especially helpful in clarifying the processes involved.

In Section 2 we begin by clarifying what we mean by prototype constructions and how this applies in the particular case of transitivity.

Section 3 focuses on acquiring the transitive in English, and explaining how the language children hear around them influences the nature of their generalizations and abstraction. In Section 4 we systematically compare German, Cantonese & Polish, highlighting the way in which the different morphosyntactic features of these languages affect the development of the prototype form of the transitive construction. Section 5 briefly discusses the effect of frequency and prototypicality in relative clauses, and how the prototype attracts errors. In section 6 we summarise what we see as the role of prototypical constructions in early language acquisition.

2. Prototypes in cognition and language

The introduction of the notion of prototype into the categorization literature by Rosch and colleagues was a revolution (e.g. Mervis and Rosch 1981; Rosch 1983). The basic idea was that a concept, for example, *bird*, was not defined by a set of necessary and sufficient features—with all members that met the criteria being equals—but rather that the concept had a graded structure, with fuzzy boundaries, in which some members played a privileged role. Thus the prototypical bird is one that shares the most features with other birds and is maximally distinct from non-birds. Similarly, the prototypical transitive clause, with two conceptually prominent participants, is taken to be maximally distinct from a prototypical intransitive.

An important finding in prototype theory is that the prototype—either an actual exemplar or a composite entity—comprises a maximal number of features common to the category, often “averaged” across exemplars. Franks and Bransford (1971) performed an experiment in which they constructed stimuli by combining geometric forms such as circles, stars, and triangles into structured groups of various kinds. Some of these were then shown to participants—who were then later asked if they recognized these and other shapes they had not seen previously. Importantly, one of the exemplars shown at test contained all of the geometric forms together, an exemplar that had actually never been shown previously (but could be considered the prototype if all of the experienced exemplars were averaged). The participants not only thought that they had seen this prototype, but they were actually more confident that they had seen it than the other previously seen exemplars (or distracter items which they had not seen). The idea of averaging across exemplars contains within it a notion of frequency. The conceptual space that prototypes occupy includes the most representative member but may also be distorted, skewed or weighted towards its most frequent members. Thus, one might say the prototypical outfit for a businessman is a suit—merely on the basis of its

high frequency. Importantly, a prototype assigns membership to a category by means of a judgement of similarity to a central exemplar so that an essential property of a prototype category is that it is gradable.

In linguistics, Lakoff (1987) applied the notion of prototype to both lexical semantics and grammatical constructions. In applying the notion to linguistic constructions, we must attend not only to function—for example, the ditransitive construction prototypically involves transfer of possession—but also to linguistic form—the ditransitive construction prototypically has the form of NP1 + VERBditrans. + NP2 + NP3. In Goldberg's (1995) version of construction grammar there is a focus on the fact that a given form often has a prototypical meaning as well as conventional extensions of that meaning. This is not just confined to metaphorical extensions of prototypical constructions to 'similar' conceptual situations (e.g., the use of the ditransitive construction for acts of information transfer and for benefactives), but also to negation, enablement, and future transfer.

In language acquisition, new exemplars will be assimilated to the prototype by analogy. For instance, when the learner is trying to comprehend the two sentences *the car is towing the boat* and *the truck is towing the car*, they do not begin by aligning elements on the basis of the literal similarity between the *two cars*, but match *the car* and *the truck* because they are doing the same job from the perspective of the functional interrelations involved. There is much evidence that people, including young children, focus on certain kinds of relations in making analogies, the most important being spatial and causal relations (Gentner and Markman 1995, 1997; Gentner and Medina 1998). Thus, crucial for making analogies across linguistic constructions is the meaning of the relational words involved, especially the verbs, and the spatial, temporal, and causal relations they encode (Tomasello 2003). It may be helpful to think of prototypes as a kind of prediction-generator. What this means is that once an abstraction is created, it allows generalisations about novel items: the more similar a new instance is to the prototype the more likely it will be to behave in a similar way (this includes linguistic behaviour). This means that the dimensions over which we compute similarity is massively constrained if children are focusing their resources on predicting the function of the forms they actually hear.

With particular regard to the transitive construction, Hopper & Thompson (1980, 1984) laid out the prototypical semantics underlying transitive constructions across many languages. They list what they call the "component parts of the Transitivity notion", representing a scale according to which clauses can be ranked as more or less transitive. More recently, Næss (2007) proposes that a basic criterion for transitivity is

formulated in the maximally distinct argument hypothesis: A prototypical transitive clause is one where the two participants are maximally semantically distinct in terms of their roles in the event described by the clause. The two-participants of a transitive clause are most commonly labelled 'agent' and 'patient'. Therefore, another way of formulating the maximally distinct argument hypothesis would be to say that the agent and patient categories should be defined in maximal opposition to each other. Thus this event is prototypically realised as an agent **intentionally instigating** an action that directly results in the patient being **affected**. The empirical predictions of Naess' model are fairly straightforward: any deviation from the prototype will lead to the use of a structure distinct from the fully transitive clause in some language. Conversely, if the semantic features of the prototype are to be taken as a sufficient definition of prototypical transitivity, then any differences in formal transitivity marking must in principle be explainable in terms of deviations from this feature configuration. There should be better-or-worse examples of transitivity where the sentence *John broke the plate* semantically overlaps with all the prototypical features described by Naess, while *John accidentally broke the plate*, *John entered the room*, *John didn't break the plate (but wanted to)* *John didn't break the plate (and didn't want to)*, all depart from the prototype along the dimensions of intentionality, instigation and affectedness of the agent or patient. So, prototypical transitivity is defined primarily as a semantic/pragmatic concept, but one with obvious structural implications, of which, the clearest are the traditional grammatical relations subject and object (which may themselves be generalisations from the core notions of agent and patient).

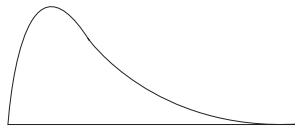
While the prototypical semantics underlying transitive constructions may be universal and express something fundamental to human experience, the morphosyntactic resources that are available to express the transitive scene vary from language to language. Furthermore, within languages the balance between the cues shifts depending on the sentence's context, the language's history, or both. Nevertheless, in many languages (including all of those we will deal with here) there are three major syntactic devices for helping to indicate who-did-what-to-whom in the transitive construction: word order, marking on one or both of the nouns (case), and marking on the verb (agreement). Of course, at some level these cues need to interface with world-knowledge, such as the animacy of the participants (Haspelmath et al. 2005) and semantic plausibility, both of which will contribute to making probabilistic formulations of the event being described.

Focusing on the averaging function characteristic of prototypes, we may thus specify the prototype of the form of the transitive construction

as one employing all or most of these syntactic devices and cues—at least those that are reasonably frequent. And so in English, something like *He's pushing it* or *He's eating the berries* can be considered prototypical exemplars of the transitive construction in that they are marked by several of the key syntactic devices and cues. If exemplars of this type are also frequent then they might have special importance in children's early acquisition of the transitive construction.

In the early stages of development, when the type/token ratio is low, the prototype will be closer to the most frequent item. As the type/token ratio increases, with more instances of that category, the average will begin to stabilize, and as the set approaches adulthood levels of exemplars, the prototype of that category will become increasing entrenched and insensitive to new members. If the type/token ratio remains low (as in the ditransitive), the prototype will remain skewed towards the mode (see Figure 1.a. below). Another way of putting this is to say the prototype of a particular functional set is weighted towards its most frequent members, so that you wouldn't conclude *read* or *pass* is as good an example of a ditransitive verb as *give* was. The frequency profile for transitives is much flatter (Figure 1.b.), although, as we have seen, they will differ in the extent to which they encode characteristic transitive semantics (Pyykkönen et al. in press).

A potential problem this presents for acquisition, however, is that if a construction is often marked redundantly with multiple cues, it may be difficult for children to isolate exactly what job each of these markers is doing—and so to generalize these markers productively. From the perspective of the memory and cognition literature this is analogous to



ditransitive [give, give, give, give, read, pass]

Figure 1(a).



transitive [get, have, want, take, find, put, do, eat, play, see, like, say...]

Figure 1(b).

the problem of compound cues for function and category learning. From the perspective of an adult conceptualization of construction grammar, redundancy is a manifestation of multiple constructions (e.g., transitive and ditransitive) coming together (through unification) to license a clausal token. The main point concerning us here is that, when a prototype construction is redundantly marked, children may not be able to isolate the syntactic markers involved—what Tomasello (2003) calls the blame-assignment problem—which will limit their productivity with them.

3. Acquiring the transitive construction in English

English children's relatively slow acquisition of the transitive construction as an abstract, verb-general construction is well established across many studies. Here we review that literature very briefly, and then attempt to explain this developmental pattern in terms of the language children hear around them and what this does and does not afford in terms of generalizations and abstraction.

3.1. The developmental pattern

In their spontaneous speech young English-speaking children use canonical SVO word order in transitive constructions fairly consistently from quite early in development (Brown 1973). Similarly, in comprehension tasks, children as young as two years of age appropriately act out "The doggie bites the cat" (reversible transitives) that depend exclusively on a knowledge of canonical word order (e.g., DeVilliers & DeVilliers 1973). We cannot conclude from these facts, however, that very young children have full productive control of English SVO word order. If we do not know what children have and have not heard, it might be that they are simply reproducing the ordering of the particular words they have heard adults using, or they might be marking SVO relations syntactically, but only locally for some highly familiar verbs (Tomasello 1992).

One source of evidence for productivity is overgeneralization errors such as *She falled me down* or *Don't giggle me*—in which intransitive verbs are used productively in the SVO transitive frame (Bowerman 1982; Pinker 1989). The basic fact here is that children seldom make such errors prior to about 3 years of age. Another source of evidence comes from experiments with novel verbs, enabling researchers to control what the child has and has not heard. In the case of English SVO transitive word order, the experiments often involve elicited production. In these experiments, children are exposed to a novel verb in a syntactic construction such as an intransitive or passive and then tested to see if they

can later use that verb productively in the canonical SVO transitive construction—with cues to syntactic roles other than word order (e.g., animacy of the S and O participants, use of case marked pronouns) carefully controlled. Experiments of this type have clearly demonstrated that by 3.5 or 4 years of age most English-speaking children can readily assimilate novel verbs to an abstract SVO schema (e.g., Maratsos et al. 1987; Pinker et al. 1987). That is, the vast majority of children from 3.5 years of age can produce a canonical transitive SVO utterance with a completely novel verb (e.g., *the cat's meeking the dog*) that they have never heard before in a transitive SVO construction. However, this is not true of younger children. In a series of studies by Tomasello and colleagues, 2- to 3-year-old children readily use a novel verb in the construction in which they have heard it modelled, but they do not use it in constructions, including the SVO transitive construction, in which they have not heard it modelled (see Tomasello 2000, 2003, for reviews). Very similar findings have come from other elicited production methods with very different response demands, such as the weird word order method of Akhtar (1999) (see also Abbot-Smith et al. 2001, and Matthews et al. 2005), and the priming methodology of Savage and colleagues (2003) (see also Shimpi et al. 2007). In all cases, children below about 3 years of age are generally very poor at producing newly learned verbs in constructions in which they have not heard them used previously.

Despite these very consistent findings using several different production methodologies, some researchers argue that production experiments are too demanding from a performance point of view (although this criticism has not been levelled against the priming methodology). The classic test of comprehension is the act-out task. For example, Akhtar and Tomasello (1997) created a modified act-out task for use with novel verbs. Children first learned to act out a novel action on a novel apparatus with two toy characters, and then the adult handed them two new characters and requested *Show me: Cookie Monster is meeking Big Bird* (while placing the apparatus in front of them). Since every child knew the names of the novel characters and on every trial attempted to make one of them act on the other in the appropriate way, the only question was which character should play which role. The under-3-year-old children were, as a group, at chance in this task, whereas older children were quite good. The other major technique used to assess children's comprehension of English word order is preferential looking. In this technique, a child is shown two displays and hears a single utterance (through a centrally located loudspeaker) that describes only one of the displays felicitously. The question is which display the child will prefer to look at. Although there are findings of children's comprehension of English word order using familiar

verbs (e.g., Hirsh-Pasek & Golinkoff 1996), and findings concerning verb semantics using novel verbs (e.g., the difference between causative and inchoative meanings; Naigles 1990), there is only one study testing SVO comprehension with novel verbs. Gertner, Fisher and Eisengart (2006) found that children as young as 21 and 25 months old preferred watching the causative event which matched with the reversible SVO sentence they heard. But this study had a training phase with familiar verbs in SVO sentences that used the exact same characters (and nouns to describe them) used in the test phase (in canonical SVO order), which could have taught the children essential linguistic and/or non-linguistic strategies. Clearly these discrimination effects are highly fragile and while they may point to an initial sensitivity to possible mappings between aspects of the sentence and events much more work needs to be done to investigate precisely what these mappings might be and whether and how they are related to children's much later ability to use a full representation of the abstract transitive construction.

Overall, then, we see a slow and gradual development of skills with English word order in the transitive construction, in both production and comprehension. We would now like to ask the question why this development is so slow, with children taking several years for a highly frequent construction.

3.2. *What English-speaking children hear*

English children's relatively slow acquisition of word order as an indicator of a verb-general transitive construction is due, we believe, to two main factors: the diversity of configurations in which S, V, and O are realised in the input, and the redundancy of the syntactic cues involved.

First, in terms of natural input, Cameron-Faulkner and colleagues (2003) looked at the child directed speech (CDS) of twelve English-speaking mothers and analysed their utterance-level constructions, amounting to nearly 17,000 utterances of CDS. Based on their sample—and broadly corroborated by similar analysis of a more diversely collected sample (Wells 1981)—they estimate that English-speaking children hear, every day, something in the order of 7,000 utterances. Over 30 percent of the utterances have no subject (e.g., imperatives, fragments), another 40 percent have the subject after either the auxiliary or main verb (e.g., questions), and of the remaining 30 percent only about half have the prototypical patient following the verb. What this means, at least for the age range sampled (1;9–2;6), is that an English-speaking child would have difficulty figuring out that SVO is supposed to be the canonical English form. The fact that children hear other combinations of S, V, and O

much more often than they hear SVO utterances may help to explain why English-speaking children take so long to construct an abstract transitive construction based on word order.

Evidence to support this interpretation comes from a training study. Childers and Tomasello (2003) gave 2 ¹/₂-year-old children several hundred transitive utterances of various types over three training sessions and then, in a fourth session, assessed their ability to use a novel verb productively in the transitive construction. For some children, the transitive utterances were modelled with nouns only (*The boy's chopping the tree*); for other children the transitive utterances were modelled both with pronouns (*He's chopping it*) and with nouns (*The boy's chopping the tree*); and some children were in a control condition with no relevant training. Only 20 percent of the children with no training produced transitive utterances with novel verbs during testing (in line with previous studies). The children who received training were much better, with roughly two-thirds generalizing with the novel verb at test—with children trained with both pronouns and nouns being especially skilful.

These results demonstrate two key points relevant to current purposes. First, when the range of SVO configurations is reduced in the input and children are given lots of exemplars in close temporal proximity, young children are capable of creating any verb-general transitive construction at younger ages than normal. Second, it is likely that many factors influence this process, at least two of which are: (i) type variation in the NP slots (as in the condition with nouns and pronouns) and (ii) case marking on pronouns (e.g., *he* is the nominative form).

The second reason that English-children may be relatively slow to acquire the word-order cue for indicating agent/patient relationships is that, as in most languages, the simple transitive construction is redundantly marked with word-order, case marking agreement, and animacy, as for instance in *He's eating it*. If all of these cues co-vary with high frequency then the learner may treat the cues as a kind of 'linguistic gestalt' with no internal structure, only breaking down into its component parts when placed in a sufficient number of different linguistic contexts where the cues are placed in conflict. This is a similar idea to a compound cue for function and category learning, a well-established phenomenon in the memory and cognition literature.

The idea is that in the novel verb experiments of Tomasello and colleagues, in almost all cases the only syntactic cue available to children was word order, with no case marking, agreement, or animacy cues available—probably a fairly rare event in young children's early linguist experience (since 80 percent of the transitive sentences they hear have pronoun subjects; Cameron-Faulkner et al. 2003). To define itself against those

other cues, word order would have to vary independently of case, animacy, and agreement with sufficient regularity—which in the real world it does not do very often. This suggests the possibility that young children could acquire a verb-general transitive construction a bit earlier if it were presented to them in prototypical form with all cues available—and that their slow acquisition is in reality a slow acquisition of the significance of the word or a cue working alone. In other words, redundancy masks that the whole has many parts, and consequently learning to use these parts productively in acquisition is delayed.

In summary, English children may be slow to acquire verb-general comprehension and production of transitive word order for two basic reasons. First, the diversity of constructions across the input makes it difficult to isolate SVO agent-patient as the most productive sentence interpretation strategy. Second, because word-order appears redundantly in the input with animacy and case-specific pronouns (and sometimes agreement), it takes time for word order to define itself against these cues, which often functionally co-vary as an indication of agent/patient relationships. One way to test these hypotheses is to systematically compare the prototype form of the transitive construction—using multiple cues redundantly—with other less informative forms, and to do this in languages whose morphology is more important to sentence interpretation than it is in English.

4. Recent cross-linguistic studies

One way to investigate the interaction of different syntactic cues in construction learning in different languages is through the theoretical framework of the competition model (Bates and MacWhinney 1987). Since the 1980s, the model has motivated cross-linguistic research in over fifteen languages with both adults and children. The model seeks to account for the differential ‘weights’ among various combinations of competing and converging cues including word-order, stress, animacy, agreement, topicalisation, prepositions, and case. The model has a functionalist approach to sentence processing; ‘the forms of natural languages are created, governed, constrained, acquired and used in the service of communicative functions’ (MacWhinney et al. 1984: 128). It argues that the strength of a particular cue is a product of how frequent it is present when it is needed (cue availability) and how consistently it is mapped onto a particular form whenever it is present (cue reliability). Cue strength is also affected by the processing limitations imposed by the perceptual and working memory systems (cue cost). At its simplest, the classical competition model conceptualises language development as a process whereby cue

strength (mediated by cue cost) comes to vary as a function of that cue's availability and reliability in the input.

One prediction from this is that children should find it especially easy to comprehend prototypical transitive sentences with both word-order and case marking (and perhaps other cues) working in coalition: the coalitions-as-prototypes model (Bates and MacWhinney 1987). But since case marking is not really a consistent feature of English (only present in the pronominal system), to do this we need other languages. Of special note in the following experiment is that, as in the English experiments reported above, novel verbs are used. In the classic competition model experiments, familiar verbs are used and so it is impossible to tell how general children's knowledge is of the syntactic markers being tested.

4.1 *German and Polish*

An excellent language for testing children's use of both case marking and word order is German. In active transitive sentences in German, the agent of the action is subject and is marked with nominative case marking, and the patient is direct object and is marked with accusative case marking. For both of these, the case marking is either a special form of pronoun or a noun with a special form of determiner. For example, if a dog is agent the form is *der Hund* (the-nominative dog) or *er* (he), whereas if a dog is patient the form is *den Hund* (the-accusative dog) or *ihn* (him). Additional complexity comes from the fact that nominative and accusative marking take different forms when applied to nouns of different genders, and in some cases they are not distinct. For example, unlike the example of *dog* above (which is masculine), if a cat is the agent the form is *die Katze* (the cat-nominative), but if a cat is the patient the form is exactly the same *die Katze* (the cat-accusative). This means that in some instances case marking is not an available cue in the sense that it does not identify case role unambiguously. Finally, although in German transitive sentences agents typically come before the verb and patients after the verb to highlight the patient pragmatically the reverse order may be used, as in English, with the case roles marked by case marking and unaffected by the reverse order. Thus, "*Den **Hund** beisst der Mann*" has the first noun, *Hund*, marked as accusative and the second noun, *Mann*, marked as nominative and so, despite word order, it is the man who is biting the dog.

Dittmar and colleagues (2008) used novel verbs to test German 2-, 5-, and 7-year olds' comprehension of case and word order in transitive sentences. For the reasons noted above, in German case marking is 100 percent reliable (although not always available, e.g., with feminine NPs)

whereas word-order is not reliable because of object first transitives (though, in some sense, always available). Below are examples of the three experimental conditions and their associated sentences in which the children had to identify the agent/patient to successfully act-out or point to the appropriate participant.

Prototype

Der Hund wieft den Löwen

(the_{masculine-nominative} dog is weefing the_{masculine-accusative} lion)

Word-order-only condition

Das Schwein tammt das Zebra

(The_{neuter} pig is tamming the_{neuter} zebra)

Conflict condition

Den Hasen bafft der Frosch

(The_{masculine-accusative} bunny is baffing the_{masculine-nominative} frog)

The results showed an astoundingly clear pattern. The 2-year-olds comprehended transitive sentences only in their prototypical form with redundant marking of agent and patient. In other words, they were the most sensitive group to cue omission, failing to comprehend transitive sentences for which the diagnostic case marking was absent or those in which the word order was non-canonical (object first). The findings suggest that in a language like German children do not begin by attending to cues individually, but rather they learn to comprehend the prototype and are impaired whenever there is deviation from it. Interestingly, the prototypical form in German is also the most frequent (calculated from a corpus of child-directed speech).

The 5-year-olds comprehended the transitive sentences mostly in terms of word-order. Their performance in the word order condition was as high as with the full prototype, and they chose at random in response to the object-first sentences in which word-order and case conflicted, with a slight tendency to go, incorrectly, with word order. Only the 7-year-olds performed like adults in going with case marking in all conditions, including in object-first sentences in which case marking and canonical word order conflicted.

This pattern of results presents a challenge to the standard cue-competition analysis; word-order is less reliable and valid than case marking in German. One possibility is that German children do not use case marking in a completely general way. This is based on the fact, noted above, that German has three noun classes so that, for example, nominative case marking has three different forms in the singular and another in the plural. If children at a particular age have not yet discovered that all

these forms mark the same case, then how the cue reliability is calculated (how reliable a cue is, when it is present, in indicating the correct interpretation) needs to reflect this. In the Dittmar and colleagues study the children were tested on the particular case markers *der* and *den* used as determiners (masculine nominative and accusative). But in children's natural input these particular items are available in only 21 percent of all transitive sentences. Therefore, children's comprehension of these may not benefit from their experience with case marking using pronouns or the case markers as expressed in other genders, in which case the cue availability of "case marking" in German is not particularly high.

Recalibrating the cue availability in this more item-based way results in the availability of case marking (as instantiated by the masculine form only) being much lower (21 percent) than that of word order (87 percent)—and this means that overall cue strength is lower for this item-based case marking as well. In line with Sokolov (1988) this suggests that young German children rely on different input parameters at different stages of development; specifically they rely more on cue availability early in development and cue reliability later on in development. We will return to the idea of children learning to connect the different case-equivalent forms when we consider data from Polish children in third and fourth year of life.

It is worth noting that adults have difficulty in processing non-canonical word orders, at least measured by reaction times (Ferreira 2003; Kaiser and Trueswell 2004). Thus, when German adults are confronted with object-first sentences which are ambiguously marked on the first noun-phrase, they initially interpret these as subject-first sentences until they hear the second noun phrase. (Weber et al. 2006). Perhaps it is not surprising then, that it was only the 7-year-olds in the Dittmar and colleagues study that succeeded in the conflict situation, weighting the case marking cue over the word cue as adults do. Following the reasoning from above this would mean that by seven years of age, children should know the grammatical equivalence of all (or at least most) of the different gendered case markers serving the same grammatical function (and should ignore ambiguities based on other information). For the 7 year-olds, the cue reliability of case marking resembles that of adults so they finally rely on case marking over word order.

In summary, older 2-year-olds understood only sentences with both cues supporting each other, but not sentences with either cue on its own. Five year-olds were able to use word order by itself but not case. Only 7-year-olds behaved like adults comprehending both cues on their own and relying on case when they conflicted. So it seems that it is only when children are somewhat older—when they have had sufficient

exposure to the grammatical cues in various combinations—that they are able to isolate and weigh them appropriately in terms of their reliabilities for signalling specific functions.

The German 2-year-olds showed that neither case nor word order presented on its own is sufficient, to guarantee comprehension. More evidence of how grouping of linguistic cues develop in learning morphological paradigms comes from a recent study by Dąbrowska and Tomasello (in press) in Polish. Polish is a morphologically rich language with a very elaborate system of case inflections. It has seven cases each signalled by different suffixes that also mark the number on the noun. The single most important determinant of the choice of ending is gender, which can be fairly reliably predicted from the phonological form of the nominative; nearly all feminine nouns end in *-a* or *-i*; the vast majority of masculines end in a consonant, and neuters typically end in *-o*, *-e*, or *-ę*. Other factors, such as the phonological make-up of the stem and semantics (especially animacy) come into play when there is more than one ending for a particular gender. The instrumental case endings are *-em* [em] for the masculine and neuter singular and *-ą* [ɔ̃w] for the feminine singular and for the masculine nouns which end in *-a* (which decline like feminines in all cases, not just the instrumental). Like other Polish cases, the instrumental is a polysemous category with a number of different functions, the most important of which are instrument (body parts), material/substance, means of transport, companion, subject predicate, ground object, and manipulated object (as in English ‘play with X’).

In the experiment children were exposed to two novel verbs of manipulation which govern the instrumental case. One of the verbs was modelled in a conjunction with three masculine patient nouns, and the other in conjunction with three feminine nouns. Sentences were then elicited with the novel verbs and new patient nouns of the same gender (the matching gender condition) and a different gender (the non-matching gender condition). The rationale for doing so was as follows. If children rely on concrete generalizations on specific case markers, they should be able to apply the correct ending to nouns of the same gender they were trained with, but not in the non-matching gender condition. On the other hand, if they have access to a more abstract instrumental construction which subsumes these concrete endings, they should be able to use the novel verb with nouns of both genders. Children could also ‘correct’ to canonical (i.e. accusative) case marking; this would indicate that they have acquired a verb-general nominative-accusative construction. The main question was thus how much children know about the instrumental as a syntactic category, specifically, whether they know that *-em* and *-ą* are both exponents of the same case.

Polish 2½-year-olds were able to supply the correct instrumental marking on the object of a novel verb governing the instrumental case even when the noun belonged to a different class than the nouns in the training set just under half the time. The 3½-year-olds were able to do so approximately 85 percent of the time, showing that they have much stronger access to an abstract instrumental category. Thus, Polish children are able to use the instrumental to mark important case relationships with novel verbs considerably earlier than English-speaking children learn to use word order productively for the same purpose, in spite of the fact that the instrumental case is relatively infrequent. The reason for this, Dąbrowska and Tomasello suggest, is that case markers are local cues in the sense that one can determine the role the noun plays in the event described in the sentence from the case marker alone, without having to hold the whole sentence in working memory.

Children's performance on these kinds of tasks, though far from perfect, was clearly systematic and reveals that the children have formed some kind of linguistic generalisation about the verbs they learned during the experiment. Polish children in third and fourth year of life learned to connect different forms of instrumental case, meaning that the child's perception of the input changes in the sense that the three different forms of the instrumental all count as evidence for the same thing—whereas before this connection they did not. This may give an answer as to why the German children in the Dittmar and colleagues study are slow to realise case is a much more valid cue in German than word order. Polish 3-year-olds have learnt to group (and so count) the instrumental endings (*-em* and *-a*) to their polysemous functions as a single cue in a way the German 3-year-olds have not yet done so with *der* and *den*. Recall that if the connection has not been made across genders and nominative and accusative in German the reliability is actually lower than word-order. This shows that some of the most critical stages in linguistic development are those where cues are grouped and regrouped to maximise the predicative power of a syntactic category to infer a function or functions. At the beginning the grouping of cues is conservative, and many items stay grammatical islands, prone to extensive revision and maybe even abandonment. Thus, children may sometimes have constructions that are somewhat incompatible with one another, so that they will vacillate between competing ways of saying the same thing (e.g. Akhtar 1999). This process continues until the weight of examples is such that the prototypes are understood in terms of the role that each of the different cues is playing in the whole construction.

4.2. *Cantonese, German and English*

Chan and colleagues (2009) examined young children's general understanding of word order and animacy contrasts as cues to the agent-patient relations in the transitive construction. They compared children acquiring different languages at different points in development using essentially the same act-out paradigm with the same sentence, object, and novel action stimuli. They tested children acquiring monolingually Cantonese, German, and English at three age levels (2;6, 3;6 & 4;6).

Cantonese, German and English are similar in having the same basic SVO word order (in pragmatically neutral situations) of simple active sentences but vary in the extent to which these cues are available or reliable and hence informative as to the meaning of their utterance. Based on calculations of cue strength, one would expect word order to be the dominant cue to agenthood in English, a prediction that has been empirically verified many times within the cue-competition model (for example Bates et al. 1984, 1987; MacWhinney et al. 1984). The situation is somewhat different for German so that apart from the canonical SVO it also allows OVS, SOV OSV, VOS and VSO, for both grammatical reasons (e.g. the verb-final rule for subordinate clauses) and for pragmatic purposes. Because the subject/agent or the object/patient is more loosely tied to position we would expect that word-order as a cue to mark agent/patient relations is not as reliable as in English. Cantonese is similar to German in this regard as it permits OVS, OSV, SOV and VOS word orders. In addition it also allows a high degree of argument noun ellipsis in natural discourse, reducing that cue's availability. Consequently, one would expect that word order is not highly reliable in Cantonese.

Animacy occupies a slightly different status as a cue to agent/patient relationships than the cues we have been considering so far because, by definition, it is an inherent semantic property of an entity rather than a grammatical convention, such as case or word order. Prototypically, agents tend to be animate and patients tend to be inanimate, so where there is an animacy contrast between two entities in a transitive sentence it is prototypical that the animate one is the agent and the inanimate one is the patient, and this should be highly reliable across languages—though certainly not always as in the sentences *the ball hit John*. In this sense the animacy cue is just a by-product of the semantics of intentionality, instigation and affectedness proposed by Næss (2007) as prototypical of transitives. In the scenario where both nouns in a sentence are animate, the animacy cue is not contrastively available (either noun could act as agent). The key here is that Cantonese is characterised by a lack of morphological cues to agent-patient relationships (no subject-verb agreement

or case) which are more readily available in German and English—and word order is not always available due to ellipsis—and so we might expect Cantonese children to rely more on animacy.

In this study, again, novel verbs were used to address the question of whether children could use their understanding of word order and animacy as cues to the agent/patient relations to interpret novel sentences. Of particular interest was whether children would find especially easy sentences in which both cues were used redundantly in conjunction (Bates & MacWhinney 1987) and they would find especially difficult sentences in which the two cues conflicted.

Cantonese-, German-, and English-speaking children aged 2;6, 3;6 and 4;6 acted out transitive sentences containing novel verbs in three conditions: (1) agent and patient were marked redundantly with both word order and animacy; (2) agent and patient were marked only with word order, and (3) agent and patient were marked in conflicting ways with word order and animacy.

When word-order was the only cue, English children showed the earliest comprehension at 2;6, then German children, and then Cantonese children at 3;6. When the cues conflicted, none of the 2;6 children in any language comprehended in adult-like ways, whereas all of the children at 3;6 and 4;6 preferred word order over animacy. These results showed that across languages, children aged 2;6 comprehend transitive sentences when they have support from the coalition of word-order and animacy, even with novel verbs. Not only are the convergent cues helpful, the *animate-verb-inanimate* sentences are also frequent in the input, and they encode the prototypical causative scene which should be highly familiar to young children in their experience regardless of their target language (see the Manipulative Activity Scene in Slobin 1985, 1997).

Reflecting on Cantonese children in particular, we may propose that they take a particularly long time to acquire word order marking of 'agent/subject' vs. 'patient/object' because (i) often there are no arguments realised in the input, and (ii) word order often appears redundantly with animacy in the prototype. These developmental results correspond well with the different properties of the languages children experience, suggesting that children's learning of syntactic marking of agent-patient relations is strongly influenced by the nature of the language they hear.

5. Relative clauses

The simple transitive construction is relatively frequent in all of the languages studied here. Relative clauses in some cases use transitive syntax,

and here we can see another effect of frequency and prototypicality, namely, that the prototype attracts errors in its direction.

Diessel and Tomasello (2005) gave English and German 4-year-olds relative clauses to imitate. It turns out that even just repeating syntactically difficult relative clauses such as genitive relatives (e.g., “This is the woman whose cat caught a mouse yesterday.”) is extremely difficult for children this young. The same is true, though less so, for oblique relatives (e.g., “This is the dog that the cat ran away from this morning”) and even object relatives (e.g., “This is the girl who the boy teased at school this morning”). Subject relatives (e.g., “This is the man who saw Peter on the bus this morning”) are easiest for children in both languages.

There are various reasons why subject relatives should be easiest for children, but it is not just frequency, as object relatives are just as frequent in the language children hear. Diessel and Tomasello stress that in subject relatives the basic syntax of the relative clause matches the transitive syntax (assuming transitivity in all cases) of the simple transitive construction used in main clauses. Strong evidence for this comes from the fact that in both languages when children made mistakes in repeating the more difficult types of relative clauses, they almost always reverted to subject relatives employing transitive or intransitive syntax (approximately 80–90 percent in both languages). This is despite the fact that in the two languages the transformations the children had to effect to make this mistake were completely different. In English the children had to transform the word order they heard to get to the easier subject relative: for example, if they heard “Here is the man that the woman kissed”, they produced “Here is the man who kissed the woman”. In contrast, in making this same mistake the German children left word order the same but had to change the case of the relativizer: for example, if they heard “Hier ist der Mann *den* die Frau küsste” (object relative: *den* = accusative case), they produced “Hier ist der Mann *der* die Frau küsste” (subject relative: *der* = nominative case). Similar phenomena have been reported in questions with long-distance dependencies (Dąbrowska in press) and complement taking verbs (Kidd et al. 2006). The main point for current purposes is simply this. The simple transitive construction serves as a kind of an already established prototype or template that has its influence as children are acquiring more complex syntactic constructions such as relative and other subordinate clauses. Prototypes attract errors in their direction.

6. Discussion

We have attempted here to explore the usefulness of the notion of prototype constructions for theories of language acquisition. There is a story to

tell both for the language children hear from the adults around them, as well as for children's own construction of linguistic representations.

We have characterized prototypicality in terms of two dimensions: frequency and maximal marking. But actually these two dimensions do not always go together in the language children hear from adults. In our proposal, adults have a prototype representation of, for example, the transitive construction in which all forms of syntactic marking (word order, case, agreement, and perhaps animacy as a semantic cue) are present. But this fully marked version may not be the one they use most frequently in speaking to young children or anyone else. This fact may have been a bit obscured in our account, given the construction and languages we chose to investigate here—as the transitive construction in both English and German is fairly frequent in something close to maximally marked form in the language children hear.

But in Cantonese and Japanese, for example, young children quite often hear transitive sentences with missing arguments, in which case none of the marking devices or semantic cues could even potentially be present. But then they hear other transitive sentences with other overt manifestations of marking, and—as the adults did in the Franks and Branford study with nonsense shapes—they glue these all together into one prototype construction. They presumably do this based on the similar meaning in the different cases. And this is where Goldberg's (2006) proposal of the special role of certain verbs might be especially useful. If children hear a variety of different transitive sentences using very different patterns of syntactic marking—but all with the exact same verb and closely related meaning—this might be the perfect situation for them to perceive the different sentences as all exemplars of the transitive construction.

And so our proposal is actually that frequency and maximal marking play very different roles in acquisition. Children will acquire first the instantiation of the construction they hear most frequently. But then they will bring together different instantiations of the construction on the basis of similar function, such that a prototype is formed including all of the marking options.

And so we might actually propose two different routes children might use to get to their own prototype representation of a linguistic construction (as well as various possible mixtures of these strategies). On the one hand, they might hear quite frequently maximally marked exemplars, for example, of the English or German transitive construction. In this case, as we have stressed above, while the redundant marking may in some sense help initial acquisition, it hinders children's ability to identify the syntactic work being done by each of the cues separately. Children will

need to do some kind of “blame assignment” by observing a particular marking device in sentences that use only it—or in different constructions. Cue availability and reliability will play a crucial role in this process.

On the other hand, if children were to hear most frequently early in development sentences with, for example, only one type of marking, then they would have to create a prototype representation by somehow bringing together with this singly marked instantiation, other singly or multiply marked instantiations of this same construction. But in this case, too, our proposal is that they end up at some point with a prototype representation involving maximal marking. One may also, of course, imagine various combinations of these two routes. For example, Cantonese children probably use some combination as they hear very frequently both transitive sentences with no arguments and transitive sentences with redundancy between animacy and word order. Despite the different specific processes involved, in all of these various developmental routes, cue availability and reliability will always play crucial roles.

Given that there are different developmental routes possible to a prototypical representation of a construction, one important avenue for future research will be to explore other construction types and in other languages. One interesting domain in which this has already been done to some extent is tense-aspect marking within the verb phrase. For example, Shirai and Andersen (1995), and Andersen and Shirai (1996), argue and provide evidence for a prototype account—based on many different languages from many different language families—in which children start using past inflections predominantly with achievement verbs, and progressive inflections with activity verbs. This is presumably because this distributional bias is found in the speech they hear around them. But in the end the children will learn to more readily use all tenses and aspects with all kinds of verbs.

Many questions still remain, such as what level of abstraction is necessary to characterise young children’s grammatical competence. A parsimonious way forward would be to suggest that the same principles govern prototypicality across linguistic and non-linguistic domains, i.e., the level of abstraction represents a trade-off between the cost of identifying a category versus its informativeness. For example, there is evidence that it is at the basic level at which entities are most likely to be named, and that these are the first words children learn for objects. As originally described by Barrett (1986) and demonstrated by Meints and colleagues (1999), prototypicality plays an important role in early word learning as children connect their first words (e.g., *bird*) to prototypical items (e.g., *a sparrow*) before they connect them to atypical items (e.g., *an ostrich*). This is a closely related (but different) idea to that of schema-instances

discussed in the cognitive grammar literature (e.g., see discussions of the ‘categorisation triangle’ in Taylor 2002). Schemas abstract what is common to all its instances and the recursive application of the schema-instance relation can be represented in a taxonomic hierarchy. Interestingly, there is evidence that multi-level taxonomies are constructed gradually in the course of acquisition from the basic-level upwards (Anglin 1986: 91). One way to think about basic levels is to say that it is the highest level in a taxonomy at which one is able to form a mental image of a concept. For instance, there may be a prototypical *bird* but there is no prototypical *furniture*, only instances of that schema. This fits with thinking about prototypes as prediction-generators; we would not expect a prototype ‘furniture’ because a piece of furniture does not have characteristic parts, nor is there a characteristic function of furniture in general. Since it has no predictive value it is not worth the processing cost of forming an abstract category (this may be analogous to constructions towards the more idiomatic end of the spectrum). There are, however, characteristic parts to a *chair* (seat, legs and back) and function (to sit on), therefore it would be worth abstracting over these instances and we can easily call to mind what this prototype would look like. So to reiterate an earlier point, instances of a schema are related by similarity from the perspective of the *functional* interrelations involved. In the current case, instances that are closer to the prototypical transitive schema should be more productive, that is, able to withstand more substitutions of features yet still be recognisable as a member of that category. The further towards the periphery of a prototype the instance is, the more it should require specialized pragmatic contexts to license such as departure. Examples of such usage-events would be the prototype ‘licensing’ metaphorical extensions or a change in figure-ground organisation, as in the passive.

Clearly prototypes will take time to assemble in development, that is, the learner must have experienced a certain threshold of exemplars from which to form an abstract category, otherwise the set of things that the category refers to is too large and uninformative. By informative we mean, able to make productive generalisations on the basis of an abstraction that are compatible with the conventions of the language. In other words, units above the basic level are generally so schematic that they are applicable to a very wide range of entities and tell you very little about the entity in question. There has been very little systematic research on the proposal that a certain number of exemplars is needed—a critical mass—before totally abstract analogies can be made (Marchman and Bates 1994). We need to take a closer look at the nature of this critical mass, for example, the reliability and availability of the linguistic cues children experience as input to the language acquisition process.

Our aim in this paper has been to add a developmental account to existing prototype theories of language processing by taking a more detailed look at one syntactic construction in four languages. Overall, we hope to have shown (i) that an abstraction is formed initially on the basis of frequent overlapping cues, so that the initial abstraction constitutes what will eventually be the prototype of a more complex, more abstract category; (ii) the importance of high-frequency forms in providing 'anchor-points' from which more abstract generalisation will gradually emerge; (iii) isolating individual cues is difficult to begin with as they often occur redundantly in the input; (iv) the construction redundantly marked with multiple cues could have a special status as a nucleus around which the prototype forms; and (v) the nature of the input, as characterised by reliability and availability, is a strong predictor of cross-linguistic differences in language acquisition. Our theoretical claim here is that there are some basic principles of frequency, reliability, and conceptual development that will be critical and play similar roles in all cases.

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